Validation of 20-Meter Corridor for the 6-Minute Walk Test in Men on Liver Transplantation Waiting List

C.A. Veloso-Guedes, S.T. Rosalen, C.M. Thobias, R.M. Andreotti, F.D.M. Galhardo, A.M. Oliveira da Silva, O. Araujo, and I.F.S.F. Boin

ABSTRACT

Background. Guidelines established by the American Thoracic Society recommend the use of corridors 30 m in length for the 6-minute walk test (6MWT). However, not all institutions have such long corridors, which hinders or prevents 6MWT performance and use of its benefits.

Objective. To compare the distances walked by male patients with cirrhosis on the liver transplantation waiting list, we performed 6MWT on corridors 20 and 30 m long.

Methods. This prospective study included 10 patients on the waiting list for liver transplantation. They underwent 2 walk tests: the first test in a 20 m corridor and the second in a 30 m corridor. We assessed physiologic variables (heart rate, oxygen saturation, arterial blood pressure) and the subjective sensation of dyspnea at rest at 6 and 9 minutes after each walk. Statistical analysis was performed using the Wilcoxon test.

Results. Data are expressed as mean ± SD. Patient age was 59 ± 10 years. The distances walked by the patients were shorter than those predicted for their age and gender (586 ± 45 m) in both tests, no significant difference was observed between the first and the second 6MWT (437 ± 101 m vs 465 ± 80 m; $P = .131$) or among the physiologic variables.

Conclusion. We concluded that a 20 m corridor can be used safely and effectively as an alternative to 30 m for the 6MWT for male patients with cirrhosis on the liver transplantation waiting list.

The liver plays a central role in metabolism, interfering with the function of almost all organs and systems. For this reason, patients with severe liver disease display various systemic manifestations of liver failure, such as metabolic disorders, malnutrition, loss of muscle mass and function, and as respiratory distress. The combination of these factors leads to global motor impairment, decreased exercise tolerance, and physical inactivity.[1–6]

One of the tests used to assess functional capacity (FC) is the 6-minute walk test (6MWT), which is described as a submaximal test, where the individual determines his own intensity of walking.[7,8] The 6MWT is easy to apply, involves low operating costs, evaluates tolerance of physical effort, effectiveness of therapies and rehabilitation programs, and functional state of the cardiovascular and respiratory systems predicts morbidity and mortality among patients with heart and lung diseases as well as transplant candidates, and is useful for research and clinical practice.[4,7–11]

Currently, guidelines to perform the 6MWT established by the American Thoracic Society (ATS) recommend the use of an indoor or outdoor corridor with a flat surface 30 m in length.[7] However, not all institutions have such long corridors to perform the 6MWT, which hinders or prevents its application and the consequent realization of its benefits. Therefore, the main objective of the present study was to compare the distances walked by male patients with cirrhosis on the liver transplantation waiting list who underwent 6MWT in corridors of 20 and 30 m in length.

From the Surgery Department, State University of Campinas, Campinas, Brazil.

Address reprint requests to Ilka de Fátima S. F. Boin, Av. Gofredo Teixeira Silva Telles, 1341, casa 77, Jd. Universitário, Araras (SP), Brazil. E-mail: ilkaboin@yahoo.com

0041-1345/11/$–see front matter
doi:10.1016/j.transproceed.2011.03.057

METHODS

Eleven patients on our liver transplantation waiting list were selected for the study. However, 1 was excluded owing to a significant decrease in oxygen saturation (SpO_2 75%) during the last minute of the first 6MWT.

The following inclusion criteria were established: a diagnosis of liver cirrhosis due to alcohol and/or hepatitis C systolic blood pressure (SBP) between 90 and 170 mm Hg, diastolic blood pressure (DBP) between 60 and 90 mm Hg, oxygen saturation (SpO_2) >90% at rest, no use of supplementary oxygen, heart rate (HR) between 50 and 120 beats/min, respiratory rate (RR) between 8 and 25 per minute and Model for End-Stage Liver Disease index ≥14. The following were considered to be exclusion criteria to participate in the study: cardiopulmonary disorders, musculoskeletal or neuromuscular disorders that limited significantly the walk, cognitive and behavioral disorders, unstable angina or uncontrolled hypertension, recent history of cardiac arrhythmias or myocardial infarction and any other clinical condition that could be aggravated by physical effort.

The 6MWT was performed first in a corridor 20 m in length, marked meter by meter, in an ambulatory area where they were accompanied. The patients were asked to repeat the 6MWT on another day, in accordance with the ATS guidelines,[7] in a 30 m corridor with a flat surface of in also marked meter by meter. Each patient underwent the tests twice with an interval of 30 minutes between them. Both tests were performed by the same examiners.

The tests consist of the patient being instructed to walk the greatest distance at the highest speed possible for a period of 6 minutes. They were also advised to discontinue the test if they experienced any symptoms of discomfort. Verbal encouragement was given every minute by using standardized phrases.

Before starting each test, arterial blood pressure was measured with a stethoscope and sphygmomanometer (Premium) by the indirect auscultatory method, HR and SpO_2 were recorded by a portable pulse oximeter (Onyx 9500), and the subjective sensation of dyspnea was assessed by the modified Borg scale. The same physiologic variables were recorded at the end of each test (6 min) and at recovery (9 min).

To predict patient performance in the 6MWT, we used the formula of Enright and Sherril (SD = [7.57 × height(cm) − [5.02 × age (y)] − [1.76 × weight (kg) − 309 m) and calculated the mean distances.[10]

For statistical analysis we used SPSS program, version 13.0, with the Wilcoxon test to compare walked distances, regarding age and body weight, according to the formula of Enright and Sherril.[10] Values of $P < .05$ were considered to be statistically significant.

RESULTS

The results are expressed as mean ± SD. The mean age of the patients was 59 ± 10.5 years. The distances walked by the patients showed no significant differences when comparing 6MWT performances on corridors of 20 m versus 30 m: 437.3 ± 100.8 vs 464.8 ± 80.0 m ($P = .131$; Table 1). These values corresponded to ~79% of those predicted by the formula of Enright and Sherril (585.7 ± 45.5 m).

Physiologic responses (HR, SpO_2, SBP, and DBP) and subjective sensation of dyspnea (Borg Scale) also showed no significant difference between the tests.

Table 1. Comparative Analysis of the Distances Walked in the 6MWT along Corridors of 20 m and 30 m Length

Variable	n	(Mean ± SD) 20 m	30 m	*P* Value
T1	10	437.3 ± 100.8	462.3 ± 76.7	.152
T2	10	437.3 ± 100.8	467.2 ± 83.9	.160
Mean T1 and T2	10	437.3 ± 100.8	464.8 ± 80.0	.131

T1 = first test; T2 = second test.
Wilcoxon test for the comparisons between the distances walked.

DISCUSSION

The prognosis of patients on the liver transplantation list is affected by the waiting time, which contributes to the onset of morbid conditions resulting from worsening of hepatic disease.[2–4]

The evaluation of physical capacity is essential for patients with functional limitations. It is useful to quantify disease severity and functional performance.[2,4] Therefore, guidelines established by the ATS for the 6MWT recommend the use of 30-m-long corridors, noting that shorter corridors require more time to reverse directions more often, changing the test results.[7] However, the results obtained from the present study showed no significant difference between the average distances walked by patients in corridors of 20 m versus 30 m length.

It is known that physical exercise alters homeostasis because it demands an instantaneous increase in energy demand by the exercised muscles and consequently, by the organism as an whole. Several physiologic responses are necessary to supply the metabolic demand, requiring autonomic, respiratory, and hemodynamic adjustments that influence cardiovascular and respiratory systems. The greater the exercise intensity the higher will be these demands.[12] We observed that the physiologic variables and the perception of dyspnea (Borg scale) behaved similarly after the tests, suggesting that the degree of effort by patients was similar in both tests.

Regarding the distance walked, the results showed that the patients displayed functional impairments, because in both tests they walked, on average, 79% of that predicted for them, according to the equation proposed by Enright and Sherril.[10] This can be explained by the hepatic impairment and by their respiratory, metabolic, neurologic, and motor complications.[1–6,13]

The 6MWT applied in this study showed good correlation with submaximal functional capacity, because it was well tolerated by participants, and, according to the Borg scale, the level of dyspnea that was achieved was light in intensity.

In conclusion, there were no significant differences in the distances walked and in the behavior of physiologic variables among patients evaluated on corridors of 20 m or 30 m length, thus validating the use of 20-m corridors for the 6MWT for male patients with cirrhosis on the liver transplantation waiting list.

REFERENCES

1. le Cornu KA, McKiernan FJ, Kapadia SA, et al: A prospective randomized study of preoperative nutritional supplementation in patients awaiting elective orthotopic liver transplantation. Transplantation 69:1364, 2000

2. Wiesinger GF, Quittan M, Zimmermann K, et al: Physical performance and health-related quality of life in men on liver transplantation waiting list. J Rehabil Med 33:260, 2001

3. Dharancy S, Lemyze M, Boleslawski E, et al: Impact of impaired aerobic capacity on liver transplant candidates. Transplantation 86:1077, 2008

4. Tomczak CR, Warburton DER, Riess KJ, et al: A prediction model for estimating pulmonary oxygen uptake during the 6-minute walk test in organ transplant recipients. Transplant Proc 39:3313, 2007

5. Duranti R, Laffi G, Misuri G, et al: Respiratory mechanics in patients with tense cirrhotic ascites. Eur Respir J 10:1622, 1997

6. Andersen H, Borre M, Jakobsen J, et al: Decreased muscle strength in patients with alcoholic liver cirrhosis in relation to nutritional status, alcohol abstinence, liver function, and neuropathy. Hepatology 27:1200, 1998

7. ATS: Statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med 166:111, 2002

8. Enright PL. The six minute walk test. Respir Car 48:783, 2004

9. Pires SR, Oliveira AC, Parreira VF, et al: Six-minute walk test at different ages and body mass indexes. Rev Bras de Fisioter 11:131, 2007

10. Enright PL, Sherrill DL: Reference equations for the six minute walk in health adults. Am J Respir Crit Care Med 158:1384, 1998

11. Hamilton DM, Hannel RG: Validity end reliability of six minute walk test in a cardiac rehabilitation population. J Cardiopulm Rehabil 20:156, 2000

12. Fargard RH: Exercise characteristics and the blood pressure response to dynamic physical training. Med Sci Sports Exerc 33:484, 2001

13. Cabre E, Gassull MA: Nutritional and metabolic issues in cirrhosis and liver transplantation. Curr Opin Clin Nutr Metab Care 3:345, 2000